

An Innovation in Building Design

A cost-cutting flat cable system for building electrification leads a representative selection of technology transfers in the field of construction



The technician pictured is installing Flat Conductor Cable (FCC) beneath a flooring of carpet tiles. Long used in aircraft and spacecraft, FCC is now

approved for installation in office buildings, offering cost savings in simplified building design, reduced installation time and ease of alteration.

Aircraft and spacecraft are marvels of compactness. They have to be. Equipment size and weight must be tightly controlled, even in the smallest components, or the craft's performance will suffer. To negate that possibility, aerospace designers have developed a multitude of ingenious weight-shaving, space-saving measures.

One such measure is the use of extremely thin flat wire—technically known as Flat Conductor Cable (FCC)—instead of the relatively thick and protrusive round cable. That doesn't sound like much of a saving until you consider the extraordinary amount of cable in a complex aerospace vehicle; the Apollo Command Module, for example, had 15 miles of wiring—and that was only one element of the three-segment spacecraft. So the cumulative gain FCC affords is of significant order.

Commercial buildings also have miles of wiring and FCC offers major advantages in design of building electrification systems. The big factor is that FCC, whose thickness approximates that of two business cards, can be mounted *on* walls and floors instead of *in* them; it can be installed beneath a carpet or along a baseboard, its essential sheathing designed to look like decor rather than plumbing. This makes possible elimination of the traditional ducting, under floors and elsewhere, necessary to accommodate conventional wiring; one study estimated that a ductless wiring system could reduce the construction cost of an office building by as much as 14 percent. And when electrification needs change, as they frequently do in commercial buildings, the surface-mounted FCC system is readily accessible. In short, FCC offers simplified building construction, reduced installation time and ease of alteration, all of which translate into substantial monetary savings.

More than a decade ago, NASA began considering ways to promote non-aerospace use of compact FCC systems. Under the Technology Utilization Program, intended to encourage secondary application of technology in the interests of national productivity, NASA funded a program in which Marshall Space Flight Center developed prototypes for several FCC applications, including a baseboard-mounted system.

Since industry participation was essential to large-scale adoption of FCC, NASA—in 1975—sponsored

formation of a consortium composed of a dozen firms engaged in electrical hardware and associated manufacturing activities. Using Marshall's early work as a departure point, the member companies pooled their resources and technology to develop complete FCC systems which encompass not only the cable but the sheathing, connectors, tools and other equipment necessary to facilitate FCC use by designers and builders.

Technology, however, was only part of the requirement. It was also necessary to secure acceptance of FCC in the National Electrical Code established by the National Fire Protection Association. NASA contracted with Technology+ Economics, Inc., Cambridge, Massachusetts to focus attention on FCC safety and feasibility and to promote general acceptance of flat cable. This two-year effort resulted in a Tentative Interim Amendment to the National Electrical Code which allows use of FCC—so far only in commercial buildings.

Four members of the NASA-supported consortium are now actively marketing FCC systems. Western Electric Company, Princeton, New Jersey has developed two FCC systems, one to be installed beneath carpeting, the other inside a low-profile base-board mounting. Similar systems are offered by two major electrical hardware firms: AMP, Inc., Winston-Salem, North Carolina and Thomas & Betts Company, Raritan, New Jersey. The Commercial Floor Systems Division of Collins & Aikman, New York, is marketing a modular carpet tile system, the only type of FCC floor covering approved by the National Electrical Code. The latter company describes the advantages of FCC:

"It requires no in-concrete cutting, access flooring or ceiling-to-floor utility poles. For the building owner, the cost savings can be \$300-400 per desk; for the tenant, cost savings can range from \$30 to \$60 per installed or relocated desk, as compared with traditional under-floor or through-floor installations."

FCC has bonus value for designers of office arrangements. Elimination of ducts and other accommodations offers new latitude in designing airy, "open landscape" office layouts, which have become increasingly popular in recent years and may find wider acceptance under the impetus of the flat cable innovation.



Flat cable permits elimination of ducts and other accommodations traditionally required for building wiring systems, thus gives designers new latitude in planning attractive "open landscape" office layouts. The plan shown was designed by Vogel-Peterson Company, manufacturer of partitions.